WHAT IS CLAIMED IS

1. A magnetic recording medium comprising:

an exchange layer structure; and

a magnetic layer provided on the exchange layer structure,

said exchange layer structure comprising a ferromagnetic layer and a nonmagnetic coupling layer provided on the ferromagnetic layer,

said ferromagnetic layer and said magnetic layer being exchange-coupled and having mutually antiparallel magnetizations,

said ferromagnetic layer and said magnetic layer satisfying a relationship $Hc1' \geq Hc2'$, where Hc1' denotes a dynamic coercivity of the ferromagnetic layer and Hc2' denotes a dynamic coercivity of the magnetic layer.

2. The magnetic recording medium as claimed in claim 1, wherein each of the ferromagnetic layer and the magnetic layer is made of a material selected from a group consisting of Ni, Fe, Co, Ni alloy, Fe alloy and Co alloy.

3. The magnetic recording medium as claimed in claim 2, wherein the Co alloy is selected from a group consisting of CoCrTa, CoCrPt and

CoCrPt-M alloy, where M is an element or alloy thereof selected from a group consisting of B, Mo, Nb, Ta, W and Cu.

4. The magnetic recording medium as claimed in claim 2, wherein each of the ferromagnetic layer and the magnetic layer is made of an alloy having CoCrPt as a main component such that a Pt content of the magnetic layer in atomic % is less than or equal to a Pt content of the ferromagnetic layer in atomic %.

5. The magnetic recording medium as claimed in claim 4, wherein the Pt content of the magnetic layer is at least 1 atomic % less than the Pt content of the ferromagnetic layer.

6. The magnetic recording medium as claimed in claim 1, wherein the ferromagnetic layer and the magnetic layer satisfy a relationship $(Hc1'/Hc1) > (Hc2'/Hc2)$, where Hc1 denotes a static coercivity of the ferromagnetic layer and Hc2 denotes a dynamic coercivity of the magnetic layer.

7. The magnetic recording medium as

claimed in claim 1, further comprising:

a ferromagnetic bonding layer disposed between the ferromagnetic layer and the nonmagnetic coupling layer,

said ferromagnetic bonding layer and said ferromagnetic layer being exchange-coupled and having mutually parallel magnetizations.

8. The magnetic recording medium as claimed in claim 1, further comprising:

a magnetic coupling layer disposed between the nonmagnetic coupling layer and the magnetic layer,

said magnetic bonding layer and said magnetic layer being exchange-coupled and having mutually parallel magnetizations.

9. The magnetic recording medium as claimed in claim 1, further comprising:

a ferromagnetic bonding layer disposed between the ferromagnetic layer and the nonmagnetic coupling layer; and

a magnetic bonding layer disposed between the nonmagnetic coupling layer and the magnetic layer,

a mutual exchange coupling between the ferromagnetic bonding layer and the magnetic bonding layer being larger than a mutual exchange coupling between the ferromagnetic layer and the magnetic layer.

10. The magnetic recording medium as claimed in claim 9, wherein each of the ferromagnetic bonding layer and the magnetic bonding layer is made of an alloy having Co or Fe as a main component, and Co or Fe contents of each of the ferromagnetic bonding layer and the magnetic bonding layer are greater than corresponding Co or Fe contents of each of the ferromagnetic layer and the magnetic layer.

11. The magnetic recording medium as claimed in claim 9, wherein each of the ferromagnetic bonding layer and the magnetic bonding layer has a thickness in a range of 0.2 nm to 5 nm.

12. The magnetic recording medium as claimed in claim 1, wherein the nonmagnetic coupling layer is made of a material selected from a group consisting of Ru, Rh, Ir, Ru alloy, Rh alloy and Ir alloy.

13. The magnetic recording medium as claimed in claim 1, wherein the nonmagnetic coupling layer has a thickness in a range of 0.4 nm to 1.5 nm.

14. The magnetic recording medium as claimed in claim 1, wherein the ferromagnetic layer and the magnetic layer satisfy a relationship $Hk1 \geq Hk2$, where Hk1 denotes an anisotropic field of the ferromagnetic layer and Hk2 denotes an anisotropic field of the magnetic layer.

15. The magnetic recording medium as claimed in claim 1, wherein the ferromagnetic layer and the magnetic layer satisfy a relationship $Hc1 < Hc2$, where Hc1 denotes a static coercivity of the ferromagnetic layer and Hc2 denotes a static coercivity of the magnetic layer.

16. The magnetic recording medium as claimed in claim 1, wherein the magnetic layer has a thickness in a range of 5 nm to 30 nm.

17. The magnetic recording medium as claimed in claim 1, wherein the ferromagnetic layer has a thickness in a range of 1 nm to 10 nm.

18. A magnetic recording medium comprising:

an exchange layer structure; and

a magnetic layer provided on the exchange layer structure,

said exchange layer structure comprising a ferromagnetic layer and a nonmagnetic coupling layer provided on the ferromagnetic layer,

said ferromagnetic layer and said magnetic layer being exchange-coupled and having mutually antiparallel magnetizations,

each of the ferromagnetic layer and the magnetic layer being made of an alloy having CoCrPt as a main component such that a Pt content of the magnetic layer in atomic % is less than or equal to a Pt content of the ferromagnetic layer in atomic %.

19. The magnetic recording medium as claimed in claim 18, wherein the ferromagnetic layer and the magnetic layer satisfy a relationship $Hc1 < Hc2$, where Hc1 denotes a static coercivity of the ferromagnetic layer and Hc2 denotes a static coercivity of the magnetic layer.

20. The magnetic recording medium as claimed in claim 18, wherein the ferromagnetic layer and the magnetic layer satisfy a relationship $(Hc1'/Hc1) > (Hc2'/Hc2)$, where Hc1' denotes a dynamic coercivity of the ferromagnetic layer, Hc1 denotes a static coercivity of the ferromagnetic layer, Hc2' denotes a dynamic coercivity of the magnetic layer, and Hc2 denotes a dynamic coercivity of the magnetic layer.

21. The magnetic recording medium as claimed in claim 18, further comprising:

a ferromagnetic bonding layer disposed between the ferromagnetic layer and the nonmagnetic coupling layer,

said ferromagnetic bonding layer and said ferromagnetic layer being exchange-coupled and having mutually parallel magnetizations.

22. The magnetic recording medium as claimed in claim 18, further comprising:

a magnetic coupling layer disposed between the nonmagnetic coupling layer and the magnetic layer,

said magnetic bonding layer and said magnetic layer being exchange-coupled and having mutually parallel magnetizations.

23. The magnetic recording medium as claimed in claim 18, further comprising:

a ferromagnetic bonding layer disposed between the ferromagnetic layer and the nonmagnetic coupling layer; and

a magnetic bonding layer disposed between the nonmagnetic coupling layer and the magnetic layer,

a mutual exchange coupling between the ferromagnetic bonding layer and the magnetic bonding layer being larger than a mutual exchange coupling between the ferromagnetic layer and the magnetic layer.

24. The magnetic recording medium as claimed in claim 23, wherein each of the ferromagnetic bonding layer and the magnetic bonding layer is made of an alloy having Co or Fe as a main component, and Co or Fe contents of each of the ferromagnetic bonding layer and the magnetic bonding layer are greater than corresponding Co or Fe contents of each of the ferromagnetic layer and the magnetic layer.

25. The magnetic recording medium as claimed in claim 23, wherein each of the ferromagnetic bonding layer and the magnetic bonding layer has a thickness in a range of 0.2 nm to 5 nm.

26. The magnetic recording medium as claimed in claim 18, wherein the nonmagnetic coupling layer is made of a material selected from a group consisting of Ru, Rh, Ir, Ru alloy, Rh alloy and Ir alloy.

27. The magnetic recording medium as claimed in claim 18, wherein the nonmagnetic coupling layer has a thickness in a range of 0.4 nm to 1.5 nm.

28. The magnetic recording medium as claimed in claim 18, wherein the ferromagnetic layer and the magnetic layer satisfy a relationship $Hk1 \geq Hk2$, where Hk1 denotes an anisotropic field of the ferromagnetic layer and Hk2 denotes an anisotropic field of the magnetic layer.

29. The magnetic recording medium as claimed in claim 18, wherein the magnetic layer has a thickness in a range of 5 nm to 30 nm.

30. The magnetic recording medium as claimed in claim 18, wherein the ferromagnetic layer has a thickness in a range of 1 nm to 10 nm.

31. A magnetic recording medium comprising:

a first exchange layer structure;

a second exchange layer structure provided on the first exchange layer structure; and

a magnetic layer provided on the second exchange layer structure,

said first exchange layer structure comprising a first ferromagnetic layer and a first nonmagnetic coupling layer provided on the first ferromagnetic layer,

said second exchange layer structure comprising a second ferromagnetic layer and a second

nonmagnetic coupling layer provided on the second ferromagnetic layer,

said first and second ferromagnetic layers being exchange-coupled and having mutually antiparallel magnetizations,

said second ferromagnetic layer and said magnetic layer being exchange-coupled and having mutually antiparallel magnetizations,

said first and second ferromagnetic layers and said magnetic layer satisfying a relationship $Hc1' \geq Hc2'$ and $Hc3' \leq Hc2'$, where Hc3' denotes a dynamic coercivity of the first ferromagnetic layer, Hc1' denotes a dynamic coercivity of the second ferromagnetic layer, and Hc2' denotes a dynamic coercivity of the magnetic layer.

32. The magnetic recording medium as claimed in claim 31, wherein:

each of said first and second ferromagnetic layers and said magnetic layer is made of a material selected from a group consisting of CoCrPt and CoCrPt-M alloy, where M is an element or an alloy thereof selected from a group consisting of B, Mo, Nb, Ta, W and Cu, and

a Pt content of the first ferromagnetic layer is smaller than a Pt content of the magnetic layer by at least 7 atomic % or, on the order of the atomic % of impurities.

33. The magnetic recording medium as claimed in claim 31, further comprising:

a magnetic bonding layer at least disposed at one location selected from a group consisting of a location between the first ferromagnetic layer and the first nonmagnetic coupling layer, a location between the first nonmagnetic coupling layer and the second ferromagnetic layer, a location between the second ferromagnetic layer and the second nonmagnetic coupling layer, and a location between the second nonmagnetic coupling layer and the magnetic layer,

said magnetic bonding layer and an adjacent one of the first ferromagnetic layer, the second ferromagnetic layer and the magnetic layer having mutually parallel magnetizations.

34. The magnetic recording medium as claimed in claim 31, wherein the magnetic layer has a thickness in a range of 5 nm to 30 nm.

35. The magnetic recording medium as claimed in claim 31, wherein at least one of the first and second ferromagnetic layers has a thickness in a range of 1 nm to 10 nm.

36. The magnetic recording medium as claimed in claim 31, wherein each of the first and second nonmagnetic coupling layers is made of a material selected from a group consisting of Ru, Rh,

Ir, Ru alloy, Rh alloy and Ir alloy.

37. The magnetic recording medium as claimed in claim 31, wherein each of the first and second nonmagnetic coupling layers has a thickness in a range of 0.4 nm to 1.5 nm.

38. The magnetic recording medium as claimed in claim 31, wherein the second ferromagnetic layer and the magnetic layer satisfy a relationship $Hk1 \geq Hk2$, where Hk1 denotes an anisotropic field of the second ferromagnetic layer and Hk2 denotes an anisotropic field of the magnetic layer.

39. A magnetic recording medium comprising:

an exchange layer structure; and

a magnetic layer provided on the exchange layer structure,

said exchange layer structure comprising a ferromagnetic layer and a nonmagnetic coupling layer provided on the ferromagnetic layer,

said ferromagnetic layer and said magnetic layer being exchange-coupled and having mutually antiparallel magnetizations,

a magnetization direction of the magnetic layer switching before a magnetization direction of the

ferromagnetic layer in response to a recording magnetic field which is applied to the magnetic layer and the ferromagnetic layer to switch the magnetization directions thereof.

40. The magnetic recording medium as claimed in claim 39, wherein the magnetization direction of the ferromagnetic layer is aligned in a direction antiparallel to the magnetization direction of the magnetic layer after a time of 1 nanosecond to 10 milliseconds elapses from a time when the recording magnetic field is applied.

41. A magnetic storage apparatus comprising:

at least one magnetic recording medium having an exchange layer structure and a magnetic layer provided on the exchange layer structure; and

a head to record information on and/or reproduce information from the magnetic recording medium,

wherein exchange layer structure comprises a ferromagnetic layer and a nonmagnetic coupling layer provided on the ferromagnetic layer,

said ferromagnetic layer and said magnetic layer are exchange-coupled and have mutually antiparallel magnetizations, and

said ferromagnetic layer and said magnetic layer satisfy a relationship $Hc1' \geq Hc2'$, where $Hc1'$ denotes a dynamic coercivity of the ferromagnetic layer and $Hc2'$ denotes a dynamic coercivity of the

magnetic layer.

42. A magnetic storage apparatus comprising:

at least one magnetic recording medium having an exchange layer structure and a magnetic layer provided on the exchange layer structure; and

a head to record information on and/or reproduce information from the magnetic recording medium,

wherein said exchange layer structure comprises a ferromagnetic layer and a nonmagnetic coupling layer provided on the ferromagnetic layer,

said ferromagnetic layer and said magnetic layer are exchange-coupled and have mutually antiparallel magnetizations, and

each of the ferromagnetic layer and the magnetic layer is made of an alloy having CoCrPt as a main component such that a Pt content of the magnetic layer in atomic % is less than or equal to a Pt content of the ferromagnetic layer in atomic %.

43. A magnetic storage apparatus comprising:

at least one magnetic recording medium having a first exchange layer structure, a second exchange layer structure provided on the first exchange layer structure, and a magnetic layer provided on the second exchange layer structure; and

a head to record information on and/or reproduce information from the magnetic recording

medium,

wherein said first exchange layer structure comprises a first ferromagnetic layer and a first nonmagnetic coupling layer provided on the first ferromagnetic layer,

said second exchange layer structure comprises a second ferromagnetic layer and a second nonmagnetic coupling layer provided on the second ferromagnetic layer,

said first and second ferromagnetic layers are exchange-coupled and have mutually antiparallel magnetizations,

said second ferromagnetic layer and said magnetic layer are exchange-coupled and have mutually antiparallel magnetizations, and

said first and second ferromagnetic layers and said magnetic layer satisfy a relationship $Hc1' \geq Hc2'$ and $Hc3' \leq Hc2'$, where Hc3' denotes a dynamic coercivity of the first ferromagnetic layer, Hc1' denotes a dynamic coercivity of the second ferromagnetic layer, and Hc2' denotes a dynamic coercivity of the magnetic layer.

44. A magnetic storage apparatus comprising:

at least one magnetic recording medium having an exchange layer structure and a magnetic layer provided on the exchange layer structure; and

a head to record information on and/or reproduce information from the magnetic recording medium,

wherein said exchange layer structure comprises a ferromagnetic layer and a nonmagnetic coupling layer provided on the ferromagnetic layer,

said ferromagnetic layer and said magnetic layer are exchange-coupled and have mutually antiparallel magnetizations, and

a magnetization direction of the magnetic layer switches before a magnetization direction of the ferromagnetic layer in response to a recording magnetic field which is applied to the magnetic layer and the ferromagnetic layer to switch the magnetization directions thereof.

45. A recording method for magnetically recording information on a magnetic recording medium by applying a recording magnetic field thereon, said magnetic recording medium having an exchange layer structure and a magnetic layer provided on the exchange layer structure, said exchange layer structure comprising a ferromagnetic layer and a nonmagnetic coupling layer provided on the ferromagnetic layer, said ferromagnetic layer and said magnetic layer being exchange-coupled and having mutually antiparallel magnetizations in a state where no recording magnetic field is applied thereon, said method comprising:

applying a recording magnetic field on the magnetic recording medium so as to satisfy a relationship $Hc1' - HE1 > Hh1$ and $Hc2' - HE2 < Hh2$, where $Hc1'$ denotes a dynamic coercivity of the ferromagnetic layer, $Hc2'$ denotes a dynamic coercivity of the magnetic layer, $HE1$ denotes an exchange field applied to the ferromagnetic layer, $HE2$ denotes an exchange field applied to the magnetic layer, $Hh1$ denotes a recording magnetic field applied on the ferromagnetic layer, and $Hh2$ denotes a recording magnetic field applied on the

magnetic layer.

46. A recording method for magnetically recording information on a magnetic recording medium by applying a recording magnetic field thereon, said magnetic recording medium having an exchange layer structure and a magnetic layer provided on the exchange layer structure, said exchange layer structure comprising a ferromagnetic layer and a nonmagnetic coupling layer provided on the ferromagnetic layer, said ferromagnetic layer and said magnetic layer being exchange-coupled and having mutually antiparallel magnetizations in a state where no recording magnetic field is applied thereon, said method comprising:

applying a recording magnetic field on the magnetic recording medium so that a magnetization direction of the magnetic layer switches before a magnetization direction of the ferromagnetic layer in response to the recording magnetic field.